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Too Close for Comfort? Social Distance and Positive Emotion Perception in Bipolar I Disorder

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Abstract

Bipolar disorder (BD) is a chronic psychiatric disorder that is associated with heightened and persistent positive emotion (Gruber, 2011; Johnson, 2005). Yet we know less about how troubled emotion responding may translate into dynamic face-to-face interactions involving others, especially in contexts where automatic social regulation of personal distance from others is key to maintaining social boundaries. Using a novel distance paradigm adapted from prior work (Adolphs et al., 2009) participants with a history of bipolar I disorder (BD; n = 30) and healthy controls (CTL; n = 31) provided online measurements of social distance preferences in response to positive, negative and neutral human target images, as well as subsequent social judgment and emotion perception ratings. Results suggest that the BD and CTL group did not differ on social distance or social judgment ratings. However, the BD group reported increased specific positive emotion perceptions (i.e., joy) to negative and positive faces compared to the CTL group. These findings contribute to a growing literature on emotion disturbances observed in BD that suggest a tendency to seek out more proximal social interactions, which may be explained by overly positive biases in emotional perception of others, specifically relevant to high arousal positive emotion and social cues.

Keywords: bipolar disorder, emotion, perception, empathy, relationships

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Recent work suggests that extremes of positive emotion may not always be adaptive for social exchanges and, in fact, there may be possible boundary conditions whereby heightened positive emotion could portend social difficulties (e.g., Gruber, Mauss, & Tamir, 2011; Gruber & Keltner, 2007). This is particularly salient among adults with a history of positive emotion disturbance, such as those diagnosed with bipolar disorder (BD) (e.g., Gruber, 2011). In particular, BD is characterized by overly intimate social contact and positive emotion biases for others (e.g., Dutra et al., 2014; Janowsky, El-Yousef, & Davis, 2003) that may portend and explain significant social functioning difficulties observed in this disorder (Dilsaver, 2011; Romans & McPherson, 2002). However, no work has directly examined the social dynamics of personal boundaries and concurrent emotional perception adults with BD. The present study employed a novel personal distance task to ascertain social distance preferences, emotion perception and social judgments among BD adults and a healthy control group.

Bipolar Disorder and Positive Emotion Disturbance

Bipolar I disorder (BD) is a severe and chronic psychiatric disorder that is associated with functional and social impairment (Sanchez-Moreno, 2009; Faglioni, 2005). In fact, BD is considered the sixth leading cause of disability amongst all medical and psychiatric conditions (Murray & Lopez, 1997). Across the United States, lifetime prevalence estimates are 1.0% for BD-I, 1.1% for BD-II, and 2.4% for subthreshold BD (Merikangas et al, 2007). Direct costs consisting of expenditures for treatment-related

(inpatient and outpatient care) and non-treatment-related expenditures (i.e. criminal justice system costs) among adults with BD, totals almost $7 billion annually (Wyatt & Henter, 1995). Given the severe and costly nature of BD an enhanced understanding of psychosocial mechanisms involved is crucial.

One important area of research has focused on emotion relevant mechanisms in BD. Recent models suggest that individuals with BD experience heightened and persistent elevations in positive emotionality across contexts (Gruber, 2011), consistent with psychosocial models implicating heightened reward seeking and goal striving in the etiology of BD (e.g., Alloy et al., 2009; Johnson, 2005). With respect to *emotion experience*, individuals at risk for, and diagnosed with BD, self-report greater positive affect in response to emotionally evocative films (Gruber, Johnson, Oveis & Keltner, 2008; Gruber, Harvey & Purcell, 2011), static photos (M'Bailara et al., 2009), and at the prospect of earning rewards (Meyer, Johnson, & Winters, 2001). People with BD also exhibit prolonged durations of self-reported positive affect during laboratory studies relative to controls (Farmer et al., 2006). In addition, BD individuals exhibit increased psychophysiological correlates of emotional responding (e.g., respiratory sinus arrhythmia) in response to positive and negative stimuli, including films, photos, and autobiographical memories (Gruber et al., 2008; Gruber, Harvey, & Johnson, 2009; Sutton & Johnson, 2002). Neuroimaging studies further suggest that individuals with BD exhibit increased activity in brain regions typically associated with emotional salience and reward (i.e., amygdala, putamen, ventral striatum, and orbitofrontal cortex) to positive stimuli (Hassel et al., 2008) and during an emotional go/no-go task (Wessa et al., 2007). Heightened positive emotionality further differentiates BD from other mood

disorders, such as major depressive disorder (MDD; Kring & Bachorowksi, 1999; Gruber, Oveis, Keltner & Johnson, 2011; Watson, Clark, & Carey, 1988), and has important clinical implications for psychosocial treatments aimed at reducing disruptive positive emotionality (e.g., Johnson, 2005).

With respect to *emotion perception*, adults who are clinically diagnosed with BD (and at risk for developing future episodes of mania) appear to exhibit difficulties in emotion perception for socially relevant cues. For example, one study found that individuals at increased risk for BD showed a bias towards detecting subtle facial expressions of positive, but not negative, emotions in pictures of other people (Trevisani, Johnson, & Carver, 2008). Moreover, currently manic BD patients reported a bias towards perceiving positive emotion even when presented with standardized images of negative facial expressions (Lembke & Ketter, 2002). Additional work by Getz, Shear, & Strakowski (2003) looked into facial affect perception in BD adults compared to demographically matched healthy controls. Results suggested that patients with BD performed significantly more poorly on all three tasks, which the authors suggest indicates that although BD participants were attending to facial cues themselves, they were unable to properly identify affective cues. Subthreshold symptoms of mania assessed in community adult couples were associated with increased positive and decreased negative emotion experience and perception between couples during negative interpersonal contexts (i.e., when one partner shared a time of distress and suffering), suggesting that symptoms of mania may be associated with "rose-colored" glasses characterized by a positively biased emotional perception even during negative social contexts (e.g., Dutra et al., 2014). Similar results suggest that self-reported risk for BD

(as measure using the Hypomanic Personality Scale; Ekblad & Chapman, 1986) predicts over-attribution of positive emotions during interpersonal touch perception tasks (e.g., Piff, Purcell, Gruber, Hertenstein, & Keltner, 2012). In this study, undergraduate participants were positioned behind a curtain that prevented them from seeing the experimenter. The experimenter would relay different touches on the participant's forearms to try to portray interpersonal emotions (e.g. awe, love, gratitude, etc.) and have the participant label the emotion from a provided list. Their results suggested that BD risk predicts a general bias toward perceiving positive emotion across several positive and negative interpersonal touches. Finally, using a validated empathic accuracy task, Devlin et al. (2014) sought to discover more regarding emotion processing within BD adults, specifically focusing on empathy. Consistent with Gruber (2011), self-reported risk for BD was associated with heightened sensitivity to accurately perceiving positive emotion experience, yet decreased ability to accurately perceive negative targets given a tendency overestimate the positive emotional experience of others. Individuals with a clinical history of BD also demonstrate decreased neural activation in regions associated with accurate interpretation of others' emotions (i.e., mirror neuron system) during a virtual social cognition task (Kim et al., 2009) as well as reduced activation in regions relating to mental state reasoning (i.e., insula, temporal cortex) during a theory-of-mind task (Malhi et al., 2008), compared with healthy controls.

Taken together, these studies indicate that both risk for and a clinical diagnosis of BD is associated with a bias toward perceiving positive emotion in others. However, these findings did not directly examine emotion experience and perception in more dynamic social contexts, thereby limiting their ecological validity (Fischer & van Kleef,

2010). This is particularly relevant given social functioning difficulties documented in BD, described below.

Bipolar Disorder and Social Functioning Difficulties

Emerging evidence suggests that focusing on interpersonal settings in BD is a particularly fertile research domain. Broadly speaking, BD is associated with pervasive difficulties in psychosocial and interpersonal functioning (e.g., MacQueen, Young, & Joffe, 2001) as well as reduced quality and quantity of social relationships (Dilsaver, 2011; Romans & McPherson, 1992). During manic mood phases, individuals with BD engage in socially inappropriate behaviors as meddling, being overly intimate during social encounters, and exhibiting increased physical contact with others including strangers (e.g., hypersexual activity). During a depressive mood phase, BD individuals have also been found to have social functioning impairments, including reporting difficulty engaging in social activities such as work (Judd, Schettler, Solomon, Maser, Coryell, Endicott, & Akiskal, 2008). Deficits in social functioning remain present even during remission in BD, including strained and limited social relationships (MacQueen et al., 2001). These studies suggest widespread social functioning impairments in BD. However, it is less clear what specific social processes may help explain social functioning difficulties in BD.

We focus on one understudied social process that may be particularly impacted in BD: namely, the maintenance of personal space in social exchanges. Indirect evidence in BD suggests that impaired social distance regulation may be apparent. For example, clinician-rated mania symptom scales include overly intimate social encounters and increased physical contact and invasion of the personal boundaries of others (i.e., sexual

interest and activity, and interpersonal meddling; Bech et al., 1979). Work by Adolphs and colleagues (2009) suggest that the ability to regulate the physical distance between oneself and another person is a vital process during social interactions (Hall, 1966; Hayduk, 1978). Empirical work on personal space difficulties to date has been limited. Of the work conducted, Adolphs et al. (2009) reported impaired personal space regulation in a patient who experienced a bilateral amygdala lesion (S.M.). Specifically, S.M. was asked to rate how comfortable she felt as another person (i.e., confederate) steadily approached her with increasing physical closeness from the other side of the room. Results suggested that S. M. preferentially chose a smaller physical distance as compared to the confederate, and also reported increased comfort with the close social distance which further could not be accounted for by the familiarity with the experimenter. The authors concluded that personal space might be heavily reliant on adequate amygdala functionality. This may be particularly relevant in BD where work suggests that structural differences in amygdala volume (15.6% reduction) and activity may differentiate BD adults from healthy controls (e.g., Blumberg, 2003). Furthermore, Barnea-Goraly et al. (2009) found that in children and adolescents with BD, abnormalities in fronto-limbic brain regions occur early in the course of illness, *especially* in the amygdala and basal ganglia. Together, these results suggest the full development of the amygdala may be impacted in BD and play a role in adaptive emotion perception in social contexts especially.

The Present Investigation

Given debilitating social problems within BD populations, the need for sensitive experimental tasks that look at the processes underlying these observed socio-emotional

difficulties is critical. The present investigation aims to systematically address these issues using a novel, dynamic social distance task adapted from the Adolphs et al. (2009) original work, in which participants provided measurements of social distance preferences in response to positive, negative and neutral human target images, as well as subsequent social judgment and emotion perception ratings. As such, it is the first study to directly examine whether BD directly influences social distance perceptions, and whether those might be understood in light of positively biased social judgment ratings and emotion perception ratings. Doing so allows us to examine whether any group relevance differences in personal distance might be explained by differential attributions in social perception (i.e., perceived connectedness, friendliness, and similarity) or emotion perception (i.e., positive and negative emotion perception).

Aim 1: Group Differences in Personal Distance. The first aim was to examine group-related differences in personal distance. We predicted the BD group would prefer a smaller personal distance (e.g. select image simulating a closer distance to the participant) as compared to the CTL group; in particular, we expected this to effect to be most apparent during the presentation of negative target facial displays (**Hypothesis 1**). This hypothesis is based on findings regarding amygdala disturbances within BD (Blumberg, 2003), as well as the findings reviewed above suggesting the role of the amygdala and personal space and emotion processing (Adolphs, 2009; Lee et al., 2004; Hassel et al., 2008; Wessa et al., 2007).

Aim 2: Group Differences in Social Perception. The second aim was to examine group-related differences in social perception, including self-report ratings of similarity, friendliness, and connectedness to the target images. We predicted that the BD

group would exhibit higher ratings of similarity, friendliness, and connectedness as compared to the CTL group; and again, that this would be most apparent during the presentation of negative target facial displays (**Hypothesis 2**). This is based on the findings that suggest BD individuals exhibit an overly positive affect towards all stimuli (Devlin et al., 2014; Dutra et al., 2014; Piff et al., 2012; Trevisani et al., 2008).

Aim 3: Group Differences in Emotion Perception. The third aim was to examine group differences in positive and negative emotion perception in the target displays. We predicted that the BD group would exhibit increased perceived positive perception compared to the CTL group. We expected this to effect to be most apparent during the presentation of negative target facial displays (**Hypothesis 3**). This hypothesis is based upon previous work demonstrating overly positive emotion perception in others during negative social contexts (Devlin et al., 2014; Dutra et al., 2014; Lembke & Ketter, 2002). Given a lack of a priori support for consistent differences in negative emotion perception in BD, we did not generate group difference predictions for negative emotion perception.

Method

Participants

All participants were recruited as part of a larger study on emotion and mood. Participants were individuals diagnosed with BD type I currently in remission (BD; n = 30) and healthy control individuals who did not meet current or past criteria for any DSM-IV-TR Axis I disorders (CTL; n = 31). In order to minimize the effects of phasic mood states on the obtained results, we focused on BD participants in remission (i.e., not

in a current manic, depressed, or mixed mood phase for at least the past month). Exclusion criteria included a lifetime history of stroke, severe head trauma, neurological disease, autoimmune disorder, severe medical condition (e.g., autoimmune disorder, cardiovascular disease, fibromyalgia, HIV/AIDS), alcohol or substance abuse in the past six months. Given that BD is highly comorbid with other disorders (e.g., Kessler, Berglund, Demler, Jin, Merikangas, & Walters, 2005), BD participants were not excluded based on psychiatric comorbidities with the aforementioned exception of substance and alcohol use disorders. See **Table 1** for demographic information and clinical characteristics.

Measures of Clinical Functioning

Diagnostic evaluation. All Axis I diagnoses were assessed using the Structured Clinical Interview for DSM-IV (SCID-IV; First et al., 2007). Trained interviewers (i.e., clinical psychology doctoral candidates and research fellows) administered the SCID-IV. Additional measures of illness duration, age of onset, and lifetime number of manic and depressive episodes were also obtained (See **Table 1**).

Mood symptoms. The Young Mania Rating Scale (YMRS; Young, Biggs, Ziegler, & Meyer, 1978) was used to measure current manic symptoms. The YMRS is an 11-item, clinician rated measure of current manic symptoms with scores ranging from 0 to 60, with higher scores indicating greater manic severity. Scores ≥ 7 represent clinically significant mania symptom levels. Current symptoms of depression were measured using the Inventory of Depressive Symptomatology-Clinician (IDS-C; Rush, Gullion, Basco, Jarrett, & Trivedi, 1996). The IDS-C is a 30-item, clinician-rated measure of current symptoms of depression. IDS-C scores range from 0 to 84, with higher scores indicating

greater depressive severity. Scores ≥ 11 represent clinically significant depressive symptom levels. The IDS-C has been validated in individuals with BD (Trivedi et al., 2004) and strongly correlates with other measures of depression severity (Rush et al., 1996). Current remitted status (i.e., neither manic, depressed, or mixed mood state) for the BD group was determined using the SCID-IV mood module criteria for the past month and cutoff scores on the YMRS (≤ 7) and IDS-C (≤ 11) for the past week. The CTL group also scored below these cutoffs.

Illness duration. We assessed illness course parameters (the number of total lifetime manic and depressive episodes, and the number of manic and depressive episodes experienced in the last 12 months) using the National Institute of Mental Health retrospective Life-Charting Methodology (NIMH-LCMr; Leverich & Post, 1993). The NIMH-LCMr procedure involves charting a participant's course of illness from the date of illness onset. The NIMH-LCMr has been well validated and used in samples of bipolar participants (e.g., Denicoff et al., 1997; Leverich & Post, 1993).

Global functioning. The Global Assessment of Functioning Scale (GAF; Spitzer, et al., 1996) was used to assess global functioning in the past week. The GAF assesses overall psychological, social, and occupational functioning on a scale from 1 (lowest level of functioning) to 100 (highest level of functioning).

Social Distance Task

We developed a novel personal distance task for the present investigation adapted conceptually from Adolphs et al. (2009). Using DIRECT RT Software (Empirisoft©), participants were presented with one of five specific facial emotion displays (neutral, happiness, anger, sadness and, disgust) for both a Caucasian male or female target, for a

total of 10 images. Facial stimuli were obtained from the validated Radboud Faces Database (Langner, Dotsch, Bijlstra, Wigboldus, Hawk, & van Knippenberg, 2010), for a total of 10 images. Specifically, participants were seated in a 6' x 7' individual testing room where they were seated in front of a 26" computer monitor that presented a single target image that appeared successively closer to the participant (i.e., image zoomed in at a larger size with each frame to simulate approach) using a total of 10 successive frames at a rate of 1 frame/second (1,000 msec), pre-programmed into a .gif video image (see **Figure 1**). Participants were instructed to press the spacebar when they felt the picture was the most comfortable distance from them as follows: "You are now going to see a different image of a person's face. The picture will start out far away, and then move closer towards you. Press the SPACEBAR when you feel the image is at the most comfortable distance from you. This can be as close or as far away as you prefer." Participants were told the video sequence would loop, so if they were unsure of what distance to choose, they could let the video cycle through until they found the distance most comfortable for them. After pressing the spacebar (logged as reaction time to press space bar in msec, accounting for multiple loops through the cycle), participants provided ratings of positive emotion perception, negative emotion perception, and social perception judgments.

For *social distance*, we quantified it in terms of the individual's reaction time (RT) to press the spacebar (msec), whereby larger values indicate less social distance (i.e., waited longer to press the spacebar reflecting closer distance to the target image). Values ranged from 1,000 msec (i.e., first of 10 frames selected, or greatest social distance) to 10,000 msec (i.e., last of 10 frames selected, or smallest social distance). If

the msec time exceeded 10,000 (i.e. participant looped through the .gif video several times), we subtracted by multiples of 10,000 msec until we had an integer less than or equal 10,000 msec to gauge specific frame preference.

For *social perception*, participants were asked to rate social connection ("How close or connected do you feel to the target?"), friendliness ("How much would you like to be this person's friend?"), and similarity ("How similar is this person to you?"). All three social perception items were rated on a 1 (not at all) to 5 (extremely) scale.

For *emotion perception*, participants were asked to rate "What is the person in the photo feeling?" for 10 distinct positive emotions (happy, awe, sexual desire, content, hopeful, grateful, love, proud, amusement, and sympathy) and 8 distinct negative emotions (angry, ashamed, scared, disgust, embarrassed, repentant/guilty, sad, contempt) on a 1 (not at all) to 5 (extremely) scale based upon the modified differential emotions scale (mDES; Cohn, Fredrickson, Brown, Mikels, & Conway, 2009).

Procedure

The present study consisted of three main parts. First, after obtaining informed consent, trained clinical psychology doctoral candidates and research fellows administered the SCID-IV, GAF, IDS-C, YMRS, and other baseline interview measures. Second, participants completed the Social Distance task (in addition to other tasks unrelated to the present study). Third, participants were thanked and debriefed.

Results

Demographic and Clinical Characteristics

As seen in **Table 1**, BD and CTL participants did not significantly differ with respect to age, gender, or ethnicity. Not surprisingly, the BD group scored lower on

global functioning and somewhat higher on YMRS scores than the CTL group. The BD group scored somewhat higher than CTL participants on subsyndromal depression symptoms. However because both groups scored well below clinically significant thresholds on the IDSC (≤ 11), and there are considerable concerns about the statistical validity of controlling for current symptoms (e.g., Miller & Chapman, 2001), we opted not to control for current symptoms in the present analyses.

Aim 1 Results: Group Differences in Personal Distance

To test Hypothesis 1, a 2 (Group: BD, CTL) x 3 (Image: Neutral, Negative, Positive) repeated-measures analysis of variance (ANOVA) was conducted for reaction time (RT in *msec*) to each of the individual images (i.e., .gif file) for each participant (explained earlier). The between-subjects independent variable was Group and the within-subjects independent variable was Image (collapsed across male and female targets, and collapsed across discrete negative image types for negative to reduce the number of comparisons)[1]. A Greenhouse-Geisser correction was used when assumptions for sphericity were not met and adjusted *p* values are reported. Effect sizes for significant results are reported as partial eta squared (η_p^2). All reported *p* values are two-tailed. Means and standard deviations are presented in **Table 2**.

For *RT*, the main effect of Image was significant, $F(1, 118) = 4.53$, $p = .020$, $\eta_p^2 = 0.071$. The main effect of Group was not significant, $F(1, 59) = 0.275$, $p = .602$, $\eta_p^2 = 0.005$; and the interaction of Group x Image was not significant, $F(2\ 118) = 1.09$, $p = .340$, $\eta_p^2 = 0.018$. Pairwise comparisons for the Image main effect indicated that across all participants, positive stimuli were allowed to come at a closer social distance than both

[1] Further analysis without collapsing male and female targets revealed parallel results.

the neutral and negative faces, and neutral faces were allowed to come at a closer social distance than the negative faces.

Aim 2 Results: Group Differences in Social Perception

To test Hypothesis 2, a 2 (Group: BD, CTL) x 3 (Image: Neutral, Negative, Positive) repeated-measures analysis of variance (ANOVA) was conducted separately for each of the three social perception items. The independent variables remained unchanged. As before, a Greenhouse-Geisser correction was used when assumptions for sphericity were not met and adjusted *p* values are reported. Effect sizes for significant results are reported as partial eta squared (η_p^2). All reported *p* values are two-tailed. Means and standard deviations are presented in **Table 2**.

For *social connection*, the main effect of Image was significant, $F(2, 118) = 41.12$, $p = .000$, $\eta_p^2 = 0.411$. The main effect of Group was not significant, $F(1, 59) = 0.275$, $p = .602$, $\eta_p^2 = 0.005$; and the interaction of Group x Image was not significant, $F(2, 118) = 1.48$, $p = .233$, $\eta_p^2 = 0.024$. Pairwise comparisons for the Image main effect indicated that across all participants, positive stimuli were rated as higher in social connection compared to both neutral and negative images, and neutral images were rated higher in social connection compared to negative images.

For *friendliness*, the main effect of Image was significant, $F(2, 118) = 59.26$, $p = .000$, $\eta_p^2 = 0.501$. The main effect of Group was not significant, $F(1, 59) = 0.264$, $p = .610$, $\eta_p^2 = 0.004$; and the interaction of Group x Image was not significant, $F(2, 118) = 0.432$, $p = .650$, $\eta_p^2 = 0.007$. Pairwise comparisons for the Image main effect indicated that across all participants, positive stimuli were rated as higher in friendliness compared to

both neutral and negative images, and neutral images were rated higher in friendliness compared to negative images.

For *similarity*, the main effect of Image was significant, $F(2, 118) = 54.199$, $p = .000$, $\eta_p^2 = 0.479$. The main effect of Group was not significant, $F(1, 59) = 0.239$, $p = .627$, $\eta_p^2 = 0.004$; and the interaction of Group x Image was not significant, $F(2, 118) = 0.725$, $p = .487$, $\eta_p^2 = 0.012$. Pairwise comparisons for the Image main effects indicated that across all participants, positive stimuli were rated as feeling more similar than both the neutral and negative stimuli, and neutral stimuli were rated as being more similar than the negative stimuli for image type.

Aim 3 Results: Group Differences in Emotion Perception

To test Hypothesis 3, a 2 (Group: BD, CTL) x 3 (Image: Neutral, Negative, Positive) repeated-measures analysis of variance (ANOVA) was conducted separately for each the positive affect (PA) and negative affect (NA) composites[2]. The dependent and independent variables remained unchanged. As before, a Greenhouse-Geisser correction was used when assumptions for sphericity were not met and adjusted *p* values are reported. Effect sizes for significant results are reported as partial eta squared (η_p^2). All reported *p* values are two-tailed. Means and standard deviations are presented in **Table 2**.

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[2] Collapsing emotions into composite emotions (i.e. positive, negative, and neutral) are described above. However, parallel results emerged when we used a multi-level model analysis to examine distinct negative displays (e.g. sad, anger, disgust). This is particularly important given that these negative emotions can produce different emotion experiences within others. For example, sadness intuitively produces a much more empathic, approach-oriented experience than anger does. In the present investigation, we speculate that displays such as anger or disgust, might be perceived as the person in the photo is angry or disgusted *with* the participant, thereby addressing different emotion perceptions, and therefore different approach/avoidance-oriented experiences of the participant.

For the *Positive Affect (PA)* composite, the main effect of Image was significant, $F(2, 118) = 349.46$, $p = .000$, $\eta_p^2 = 0.856$. The main effect of Group was not significant, $F(1, 59) = 0.379$, $p = .512$, $\eta_p^2 = 0.006$; and the interaction between Group x Image was not significant, $F(2, 188) = 1.44$, $p = .241$, $\eta_p^2 = 0.002$. Pairwise comparisons for the Image main effect indicated that across all participants, positive stimuli were perceived as more positive compared to both neutral and negative stimuli, and the neutral stimuli were perceived as more positive compared to the negative stimuli for image type.

Given a priori interest in specific high-arousal positive emotions implicated in BD (Gruber & Johnson, 2009), we also explored individual positive emotion items (i.e., amusement, awe, contentment, joy, grateful, hopeful, love, proud, sexual, sympathy). For *glad/happy* (a high arousal positive emotion), we found a significant Group x Image interaction, $F(1, 118) = 3.13$, $p = .0.047$, $\eta_p^2 = 0.050$. Follow-up univariate ANOVAs for each image indicated that the BD group perceived greater joy in both negative faces (BD: $M = 2.05$, $SD = 0.13$; CTL: $M = 2.23$, $SD = 0.43$; $F(1,59) = 5.22$, $p = .026$, $\eta_p^2 = 0.08$) and positive faces (BD: $M = 5.62$, $SD = 0.49$; CTL: $M = 5.29$, $SD = 0.74$; $F(1,59) = 4.13$, $p = .047$, $\eta_p^2 = 0.07$). Groups did not differ in positive emotion perception for neutral faces (BD: $M = 2.65$, $SD = 0.66$; CTL: $M = 2.71$, $SD = 0.75$; $F(1,59) = 0.11$, $p = .743$, $\eta_p^2 = 0.002$). For *amusement*, we cautiously note similar trends for a Group x Image interaction, $F(2, 188) = 1.985$, $p = .142$, $\eta_p^2 = 0.033$, suggesting similar increases in perceived amusement for positive and negative, but not neutral, faces in the BD compared to CTL group (See **Table 2**).

For the *Negative Affect (NA)* composite, the main effect of Image was significant, $F(2, 118) = 178.00$, $p = .000$, $\eta_p^2 = 0.751$. Pairwise comparisons for the Image main effect

indicated that across all participants, negative stimuli were perceived as more negative compared to both neutral and positive stimuli, and the neutral stimuli were perceived as more negative compared to the positive stimuli for image type. The main effect of Group was not significant, $F(1, 59) = 0.389$, $p = .535$, $\eta_p^2=0.007$; and the interaction between Group x Image was not significant, $F(2, 188) = 1.45$, $p = .237$, $\eta_p^2=0.024$.

Although we did not find any significant Group x Image interactions for the NA composite, we examined three specific negative emotions that matched the target images including anger, disgust and sadness. For *anger* (a high arousal negative emotion), we found no significant Group x Image interaction, $F(2, 554) = 1.328$, $p = .266$. For *disgust*, no significant Group x Image interaction was found, $F(2, 554) = 0.370$, $p = .691$. Finally, for *sadness*, no significant Group x Image interaction was found, $F(2, 554) = 0.607$, $p = .545$.

Discussion

The present study used a novel personal distance task to examine important but understudied socio-emotional processes in BD, including social distance preferences, emotion perception and social judgments among bipolar adults and a healthy control group. Results did not suggest broad group differences in social distance or judgment ratings; however, results provided support for an emerging literature suggesting overly positive biases in perceiving emotions of others. These results speak to the possibility of biased emotion perception in social functioning difficulties in BD.

Aim 1: Group Differences in Social Distance

The first aim was to find differences in RT msec between groups to examine personal space preference. Based on literature suggesting BD differences in proximal

social distances, we predicted that the BD group would prefer a smaller personal distance compared to the CTL group; in particular we predicted this effect to be most apparent in presentations of negative target facial displays. Our results did not support this prediction, and we did not find the BD group to prefer closer social distances for positive, negative, or neutral faces compared to the CTL group. These results diverge from literature that would suggest closer social interaction preferences within BD participants (Bech et al., 1979; Adolphs et al., 2009; Blumberg et al., 2003). Specifically, these studies show that complete bilateral lesions deplete personal boundaries entirely (Adolphs et al., 2009), therefore social approach is heavily reliant on adequate amygdala functionality, where BD individuals have shown significant volume reductions compared to that of healthy controls (Blumberg et al., 2003), which may explain why BD individuals tend to exhibit overly intimate social encounters (Bech et al., 1979). However, we did not find these results to support this hypothesis.

At the same time, we note that *all* participants allowed positive stimuli to come at a closer social distance than both negative and neutral stimuli, however our results revealed no main effect of group. As one could imagine, approaching positive emotions (e.g. happiness) is less threatening than that of negative affect (e.g. anger), which may be reflected here. The lack of difference between groups in RT across the stimuli may imply that the evolutionary social approach mechanisms remain intact in BD during remission and therefore, personal space preference cannot account for the social difficulties seen in BD. Because BD is characterized by overly intimate social contact and positive emotion biases for others, a clear understanding of the approach mechanisms underlying BD is crucial for adequate treatment (Dutra et al., 2014; Janowsky, El-Yousef, & Davis, 2003).

Our results suggest these approach mechanisms of BD adults remain intact, which implies these mechanisms are not extremely important to address during treatment however further investigation is necessary.

Our results may also diverge from previous research given the remitted state of the BD patients recruited. Perhaps our data would not reflect the pervasive difficulties in psychosocial functioning and interpersonal meddling that has been robustly observed to occur within the manic episodes of the disorder (e.g. McQueen et al., 2001; Bech et al., 1979). Of the research we examined, no study measured the extent of intimate social encounters and increased physical contact with others within BD individuals during remission, and so these results may suggest a potential area of social functioning difficulties that may be state-dependent rather than persistent into remission. This may be reflected in our findings of the present study. Therefore, if nothing else, this study may imply that these pervasive social difficulties arise as a result of manic episodes, and persist even though the episode has subsided. Although numerous literature points to social difficulties even in remission within BD populations (e.g. McQueen et al., 2001; Dilsaver, 2011; Romans & McPherson, 2002), our findings suggest that BD individuals currently in remission, do not seek out more proximal social interactions. The utilization of different types of facial emotion displays, such as disgust (e.g., Lembke & Ketter, 2002), may also yield different group related differences and warrants further future investigation.

Aim 2: Group Differences in Social Perception

The second aim examined group differences in social connection, likability, and similarity ratings to gain insight into social perception differences. We predicted our

results to align with previous literature (e.g. Dutra et al., 2014) in that the BD group would exhibit higher ratings of similarity, friendliness, and connectedness as compared to the CTL group. We predicted that this would be most apparent during the presentation of negative target facial displays. Interestingly, we did not find support for the BD group differing in social perception ratings from the CTL group. Rather, we found that both groups exhibited similar social perception ratings whereby across all participants, positive stimuli were rated as higher in social connection, friendliness, and similarity than both the neutral and negative stimuli, and neutral stimuli were rated higher in each social perception rating than negative stimuli for each image type.

For the BD group, the lack of group differences diverges from previous work suggesting potential overly positive prosocial estimates of others, possibly biased by the overly positive estimations of others (Dutra et al., 2014; Devlin et al., 2014; Kim et al., 2009; Mahli et al., 2009). However, it is important to note that none of these studies directly measured social perception judgments overtly (but rather measured emotion perception ratings indirectly) and as such our investigation is one of the first to directly examine these social judgment ratings and objective behavioral indices of social distance. As the BD group showed no difference compared to the CTL group, this finding may imply that BD individuals do not perceive others as more likable, more likely to become friends, or as more similar to them. With a more nuanced approach, our findings may prove interesting when probing social perception within BD individuals as this important area of social functioning seems to be preserved in BD, contrary to our original hypothesis. Therefore, social perception may not account for the social difficulties seen in BD. Again, this has major implications in BD treatments in that treatment should not

focus on improving social perceptions, but rather focus on improving ways in which BD individuals perceive the emotionality of others (as discussed further in the next section; e.g., Johnson, 2005). Research regarding empathic emotionality within BD individuals suggests BD individuals tend to exhibit overly positive estimations of social perceptions (e.g. Devlin et al., 2014) which may prove to reflect emotion perception deficits rather than deficits in social perception cues.

Aim 3: Group Differences in Emotion Perception.

The third aim examined emotion perception and experience reports in order to understand emotion differences between groups. We predicted to find similar results to discussed literature, expecting to find an overly positive appraisal of target stimuli. We predicted that the BD group would exhibit increased perceived positive perception compared to the CTL group. In particular, we expected this to effect to be most apparent during the presentation of negative target facial displays based on research suggesting deficits in identifying negative affect such as disgust and anger (e.g. Lembke & Ketter, 2002; Getz et al., 2003; Trevisani et al., 2008). For positive emotion perception, the BD group did not differ in global PA perception suggesting that the BD individuals are attending to and accurately identifying them, diverging from findings of Getz et al. (2003). However follow-up analyses examining more discrete positive emotions revealed differences regarding the specific high arousal positive emotion of others as *glad/happy* in negative and positive faces which is important given work implicating, not all, but specific high arousal positive emotions in BD (Gruber & Johnson, 2009). Specifically, Gruber and Johnson reported that BD risk was associated with the tendency to experience reward (joy) and achievement (pride) positive emotions. This may suggest that

individuals with BD may primarily focus on personally beneficial positive emotions such as reward and achievement. Similar to findings of Dutra et al. (2014), this may reflect an association with "rose-colored" glasses characterized by a positively biased emotional perception even in negative contexts. In addition, similar results found by Piff et al. (2012) suggest BD individuals over attribute positive emotions during interpersonal perception tasks. This, in turn, may explain some of the social difficulties that arise within BD (e.g. Dilsaver, 2011; Romans & McPherson, 2002), as the perception of high arousal positive emotions may be perceived more personally beneficial than that of healthy individuals.

With respect for negative emotion perception, we did not find any differences– neither in collapsed, or in discrete (i.e. sad, disgust, anger) emotion displays. This is consistent with previous work, which does not suggest that those at risk for BD differ in how negative they perceive the emotions of others (e.g., Devlin et al., 2014). This is less consistent with work in healthy couples whereby higher symptoms of self-reported mania predict decreased empathic accuracy for gauging a romantic partner's self-reported negative emotions (Dutra et al., 2014). Interestingly, our findings did not align with the findings of Lembke & Ketter (2002) where BD participants were found to differ from CTLs in the perception of negative affect of fear and disgust. We did not address fear, which may account for the lack of significant findings here, however BD individuals did not differ in the perception of disgust. This may suggest that the mechanism for the recognition of disgust remains intact in BD, which may imply that avoidance-oriented emotion perceptions are not impaired among BD individuals. We find this interesting given that BD is characterized by overly intimate social contact (e.g. Dutra et al., 2014;

Janowsky et al., 2003). Therefore, this may imply that BD individuals attend to and recognize disgust socially, but fail– or even neglect– to adjust their behavior appropriately. We speculate that disgust may be misperceived as more positive, based on research from Devlin et al. (2014), which may account for some the social difficulties that arise within BD adults (e.g. Dilsaver, 2011; Romans & McPherson, 2002) and could be a possible focal point for treatment of the disorder.

This may have clinical implications for BD adults in that treatment needs not to focus on establishing appropriate personal space techniques, or improving social perception strategies. Rather, our results may imply that treatment should focus on a) improving the perception of specific high arousal positive emotions in others, b) educating the patient and their families about the possibility of increased and overly intimate contact during manic episodes, and c) improving strategies for patients to prepare for and handle manic symptoms.

Limitations and Future Directions

The present investigation should be interpreted understanding several limitations. First, the present investigation only sampled an initial range of five specific emotion displays. Future studies should include examine additional discrete emotion displays, especially those relevant to social connection (e.g., love, compassion) to gain further insight into social distance and functioning. Second, we relied on the exclusive use of static photos and. gifs within a computer program, which may pose threats to this study's ecological validity. A more ecologically valid task with real-world dynamic, naturalistic social interactions might produce more pronounced effects. For example, we speculate that utilizing actors trained to portray standardized, specific emotion displays while

approaching participants, will produce much more intense emotionality experiences that will address more ecologically valid personal space preferences. In this way, we can examine if group differences emerge when utilizing real people versus static computer displays. Third, a continuous rating scale may have allowed us to pick up on more dynamic and subtle reports of social discomfort, thereby producing moment-by-moment intensity ratings for each scenario as well. This proposes a possibility for future research involving the number of people in the approach task. Fourth, examining approach towards a group and/or as a group may produce effects of a different caliber. Either of these scenarios addresses different social distance preferences, which may provide important information regarding social functionality of BD adults. Fifth, as mentioned above, future studies should examine the behavior and social distance preferences among BD individuals who are not in remission. Because mania is associated with overly intimate social contact and positive emotion biases for others (Dutra et al., 2014; Janowsky, El-Yousef, & Davis, 2003), it is crucial to understand the possible implications of mania and social distance. Finally, this study exclusively used Caucasian facial affect displays. Although the affective facial displays are universal, biases may still arise affecting perceptions overall. Future studies should attempt to use a variety of races to avoid this bias.

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Table 1. *Demographic and Clinical Characteristics.*

	BD (n = 30)	CTL (n = 31)	Statistic
Demographic			
Age (Yrs)	29.84 (9.85)	30.06 (8.58)	F = .008
Female (%)	52.0%	58.1%	χ^2 = .206
Caucasian (%)	80.0%	83.9%	χ^2 = .141
Employed/Student (%)	83.3%	93.6%	χ^2 = 7.34
Partnered (%)	62.5%	71.0%	χ^2 = 5.51
Number Children	0.21 (0.59(	0.17 (0.46)	F = 0.09
Clinical			
YMRS	1.80 (1.96)	0.90 (1.11)	F = 4.67*
IDS-C	3.72 (2.26)	1.45 (1.39(	F = 21.28***
GAF	73.08 (11.05)	89.45 (3.02)	F =62.57**
# Medications	1.68 (1.38)	--	--
# Depressive Episodes	17.15 (23.25)	--	--
# Manic Episodes	8.48 (9.75)	--	--

Note. BD=Bipolar I disorder group; CTL=Healthy control group; Employed=Employed or student status full-time or part-time; Partnered=Married or Live-in-Partner; YMRS=Young Mania Rating Scale; IDS-C=Inventory to Diagnose Depression; GAF=Global Assessment of Functioning; # Medications=the number of psychotropic medications currently taken (including anticonvulsants, lithium, neuroleptics, anxiolytics, stimulants, antidepressants, and sedative-hypnotics); Mean values are displayed with standard deviations in parentheses where applicable. $*p < .05$; $**p < .01$

Table 2. *Means and Standard Deviation Scores for Personal Distance, Emotion Perception, and Social Perception Variables by Diagnostic Group*

	BD (n = 30)	CTL (n = 31)	All (n = 61)
Social Distance			
Reaction Time (RT)			
Neutral Face	2849.22 (2333.97)	2414.42 (2293.75)	2628.25 (2304.69)
Positive Face	4019.47 (4275.68)	3215.34 (3856.89)	3610.81 (4054.40)
Negative Face	2434.76 (1871.22)	2747.88 (1581.60)	2593.89 (1722.79)
Social Perception Ratings			
Social Connection			
Neutral Face	3.07 (0.90)	3.10 (0.94)	3.08 (0.91)
Positive Face	3.73 (1.00)	4.11 (1.16)	3.93 (1.09)
Negative Face	2.77 (0.65)	2.71 (0.50)	2.74 (0.57)

Friendliness			
Neutral Face	3.32 (0.81)	3.35 (0.95)	3.34 (0.88)
Positive Face	4.12 (1.01)	4.34(1.11)	4.23 (1.06)
Negative Face	2.86 (0.69)	2.85 (0.54)	2.86 (0.61)
Similarity			
Neutral Face	3.62 (0.98)	3.89 (1.10)	3.75 (1.04)
Positive Face	4.43 (0.96)	4.42 (1.16)	4.43 (1.06)
Negative Face	3.10 (0.70)	3.14 (0.84)	3.12 (0.77)
Emotion Perception Ratings			
PA			
Neutral Face	2.87 (0.52)	2.78 (0.55)	2.83 (0.54)
Positive Face	4.49 (0.58)	4.32 (0.67)	4.40 (0.63)
Negative Face	2.24 (0.20)	2.34 (0.38)	2.29 (0.30)
NA			

Neutral Face	2.68 (0.62)	2.51 (0.57)	2.59 (0.59)
Positive Face	2.09 (0.15)	2.18 (0.39)	2.13 (0.30)
Negative Face	3.61 (0.64)	3.50 (0.55)	3.56 (0.60)
Specific Positive Emotion			
Amused	3.18 (0.60)	3.30 (0.62)	3.21 (0.62)
Awe	2.78 (0.65)	2.73 (0.70)	2.76 (0.69)
Content	2.78 (0.65)	2.73 (0.70)	2.76 (0.77)
Joy/Glad	3.44 (0.42)	3.41 (0.64)	3.43 (0.56)
Grateful	3.17 (0.58)	3.26 (0.83)	3.21 (0.73)
Hopeful	3.41 (0.55)	3.35 (0.69)	3.43 (0.64)
Love	3.27 (0.65)	3.17 (0.70)	3.22 (0.67)
Proud	3.63 (0.74)	3.47 (0.81)	3.55 (0.78)
Sexual/Desire	2.56 (0.63)	2.41 (0.61)	2.49 (0.62)
Sympathy	3.11 (0.81)	2.93 (0.81)	3.02 (0.81)

Note. BD=Bipolar I disorder group; CTL=Healthy control group; RT = reaction time in msec, with larger values reflecting less personal distance (i.e., waited longer to press the

spacebar reflecting closer distance to the target image); PA=Positive Affect; NA=Negative Affect. All values are collapsed across male and female images for each image category. Ratings are on a 1 (not at all) to 5 (extremely) scale for all social and emotion perception variables.

Figure 1. Social Distance Task Sample Trial

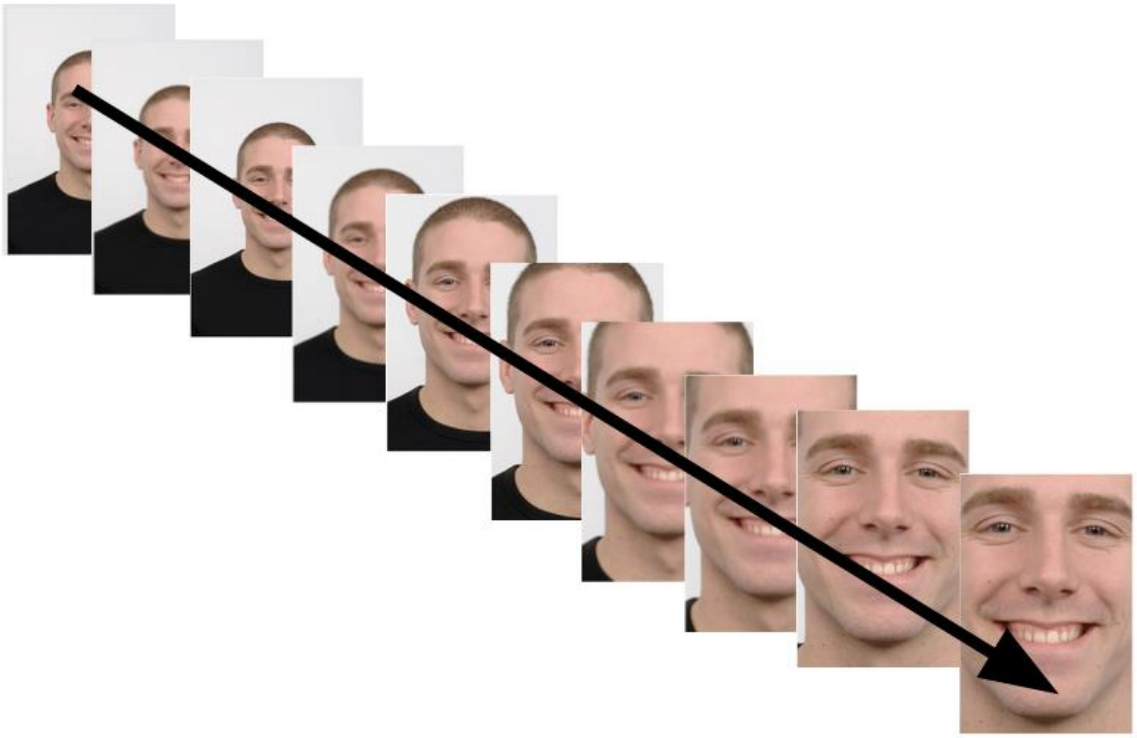

Figure Caption

Figure 1. Ten successive static photos presented for 1,000 msec each, simulating approach in this decomposed .gif file. Participants were told to press the SPACEBAR when they felt the image was at the optimal distance for interaction. RT (msec) was recorded once the participant pressed the spacebar. This specific figure was presented for each specific emotion display with identical trial structure.